WHAT IS CLAIMED IS

1. An optical attenuator device for improving a homogeneity of a beam of radiation for use in a lithographic apparatus, said optical attenuator device comprising at least one optical attenuator element which removes at least a part of said radiation from said beam of radiation.

2. The optical attenuator device according to claim 1, wherein the at least one optical attenuator element is movable such that a cross-sectional area as presented to the beam is modifiable while a 3-dimensional shape of said optical attenuator element remains mirror symmetrical with respect to a line parallel to a propagation direction of the beam of radiation.

3. The optical attenuator device according to claim 2, wherein the at least one optical attenuator element comprises at least two sheets having edges, said sheets being connected to each other at a common edge, and wherein said optical attenuator device further comprises an actuator constructed and arranged to move at least one of said sheets with respect to another of said sheets, around an axis formed by said common edge.

4. The optical attenuator device according to claim 3, wherein said at least two sheets comprise an electrically conducting material, and wherein said actuator comprises an electrical source connected to said electrically conducting material, constructed and arranged to charge said electrically conducting material.

5. The optical attenuator device according to claim 4, wherein said at least two sheets are suspended by electrically conducting wires which connect the electrically conducting material to the source.

6. The optical attenuator device according to claim 1, wherein the at least one optical attenuator element comprises one of a ribbon and a wire having a width profile which varies over its length.

7. The optical attenuator device according to claim 6, wherein the optical attenuator element has a length which is at least two times as long as a portion thereof which is present in the beam of radiation, and wherein said optical attenuator element is movable with respect to the beam by means of an actuator respectively.

8. The optical attenuator device according to claim 6, wherein said optical attenuator element is wound on two reels, said optical attenuator device further comprising a reel drive for moving the optical attenuator element with respect to the beam.

9. The optical attenuator device according to claim 1, wherein said at least one optical attenuator element comprises a first mirror and a second mirror and a mirror actuator, wherein a slit is present between said first and second mirror, wherein at least one of mirror is movable with respect to the beam of radiation by the mirror actuator, so as to vary the slit width.

10. The optical attenuator device according to claim 9, wherein the slit is located in a central part of said beam.

11. The optical attenuator device according to claim 9, wherein at least one of said first mirror and said second mirror comprises a plurality of mirror segments, which are movable with respect to the beam of radiation.

12. The optical attenuator device according to claim 1, wherein the at least one optical attenuator element comprises at least one optical filter element which comprises a body that has at least one channel therein and is made of a material which is transparent to said radiation, wherein the channel is fillable with a medium.

13. The optical attenuator device according to claim 12, wherein the optical attenuator device further comprises an injector to controllably fill said at least one channel.

14. The optical attenuator device according to claim 13, wherein said injector is constructed and arranged to fill the at least one channel with a controllable amount of a material having a higher specific absorption for the radiation than the medium.

15. The optical attenuator device according to claim 1, wherein said optical attenuator element comprises an optical filter element having an optical density which varies as a function of position along a length of the optical filter element, wherein the optical filter element is rotatable with respect to the beam of radiation.

16. The optical attenuator device according to claim 1, wherein said at least one optical attenuator element comprises at least two optical filter elements, each having an optical density which varies as a function of position along a length of the optical filter element, at least one of said optical filter elements being rotatable with respect to another of said filter elements.

17. The optical attenuator device according to claim 16, comprising a first optical filter element, having an optical density which varies as a first function of position along a length of the first optical filter element, and a second optical filter element, having an optical density which varies as a second function of position along a length of the second optical filter element, wherein the first function is substantially a reciprocal of the second function.

18. The optical attenuator device according to claim 1, wherein said at least one optical attenuator element comprises a plurality of mutually parallel strips which are movable into the beam of radiation and which comprise a material which is between 10% and 100% transparent for said radiation.

19. The optical attenuator device according to claim 18, wherein the strips comprise a material which is between about 80% and about 100% transparent for said radiation.

20. The optical attenuator device according to claim 18, further comprising an actuator constructed and arranged to move said strips with respect to said beam.

21. The optical attenuator device according to claim 18, wherein said optical attenuator device comprises a first plurality of mutually parallel strips which are movable into the beam of radiation from a first side thereof, and a second plurality of mutually parallel strips which are movable into the beam of radiation from a second side opposite the first side.

22. The optical attenuator device according to claim 21, wherein the strips of the first plurality of strips are movable in a first plane, and the strips of the second plurality of strips are movable in a second plane that is parallel to and non-coplanar with the first plane.

23. The optical attenuator device according to claim 22, wherein at least one strip is movable into a position in which said at least one strip partly overlaps at least one other strip.

24. The optical attenuator device according to claim 21, wherein an axis of symmetry of at least one strip of said first plurality of strips is displaced with respect to a corresponding axis of symmetry of at least one strip of said second plurality of strips.

25. The optical attenuator device according to claim 24, wherein said axis of symmetry of at least one strip of said first plurality of strips is displaced with respect to a corresponding axis of symmetry of at least one strip of said second plurality of strips by half a width of said at least one strip of the first plurality of strips.

26. The optical attenuator device according to claim 21, wherein the strips of the first plurality of strips extend in a first direction, and wherein the strips of the second plurality of strips extend in a second direction that is non-parallel with the first direction.

27. The optical attenuator device according to claim 1, wherein the at least one optical attenuator element comprises a mirror and at least one radiation blocking element which is movable through an opening in said mirror.

28. The optical attenuator device according to claim 1, wherein said at least one optical attenuator element comprises a filter which comprises a substrate of a material which is transparent for said radiation, and a coating on said substrate, wherein said coating comprises at least one of an anti-reflection coating and an absorptive coating, wherein only on a part of said substrate said coating is present, said part having a length in a longitudinal direction and a width that varies over the length.

29. The optical attenuator device according to claim 28, wherein said width varies as a function of position in said longitudinal direction, which function corresponds to a reciprocal of an integrated intensity of the beam of radiation, as integrated in a direction perpendicular to said longitudinal direction and as measured at substrate level without said optical attenuator device in place.

30. The optical attenuator device according to claim 28, wherein said part has an axis of symmetry in the longitudinal direction.

31. A filter, comprising:

a substrate having a surface; and

an anti-reflection coating, wherein said anti-reflection coating is present on a central part of the filter, said central part of the filter extending in a longitudinal direction from one edge of the filter to an opposite edge of the filter and having a length in said longitudinal direction and a width in a direction perpendicular to the longitudinal direction, wherein said width varies over said length, said central part of the filter having a homogeneous transmission of at least 90% for a predetermined type of radiation, wherein a transmission of said central part of the filter is greater than other parts of the filter.

32. The filter according to claim 31, wherein the transmission of the remaining part is substantially homogeneous.

33. The filter according to claim 31, wherein said central part of the filter has a homogeneous transmission of at least 98% for the predetermined type of radiation, wherein

said other parts have a substantially homogeneous transmission that is lower than the transmission of said central part of the filter.

34. The filter according to claim 31, wherein the central part of the filter has a shape with an axis of symmetry parallel to said longitudinal direction.

35. A method for manufacturing a filter comprising:

providing a substrate having a surface and having a transmission of at least 90% for a predetermined type of radiation;

applying a removable material on a portion of the surface, such that a central part of the filter is kept free from said removable material, wherein said central part of the filter extends in a longitudinal direction from one edge of the substrate to an opposite edge of the substrate and having a length in said longitudinal direction and a width in a direction perpendicular to the longitudinal direction, wherein said width varies over said length as a predetermined function of position along said length;

applying an anti-reflection coating over both the removable material and another part of the surface; and

removing the removable material together with the anti-reflection coating that has been applied over said removable material.

36. A radiation system constructed and arranged to provide a beam of radiation with a homogeneous intensity distribution, comprising a source of radiation, a collector constructed and arranged to collect said radiation into the beam of radiation, and an optical attenuator device comprising at least one optical attenuator element which removes at least a part of said radiation from said beam of radiation.

37. The radiation system according to claim 36, further comprising a mirror comprising a plurality of facets that are arranged in the beam of radiation, each facet constructed and arranged to reflect a part of the beam of radiation as a reflected partial beam, such that at least two of said reflected partial beams overlap at a predetermined distance from the mirror,

wherein the optical attenuator element comprises at least one rod located between the collector and the mirror, wherein the rod extends in a direction perpendicular to the propagation direction of the beam of radiation.

38. The radiation system according to claim 37, wherein the at least one rod is rotatable around an axis which extends substantially parallel to the propagation direction of the beam of radiation and which intersects the rod.

39. The radiation system according to claim 37, wherein the at least one rod has a cross-sectional profile that varies over a length of the rod.

40. The radiation system according to claim 37, wherein the at least one rod that has a cross-sectional profile that varies over a length of the rod is rotatable around an axis that extends through the rod parallel to the direction of the length.

41. The radiation system according to claim 37, wherein the at least one rod is expandable to locally vary its effective cross-sectional area with respect to the beam of radiation.

42. The radiation system according to claim 37, comprising at least two rods that enclose an angle between each other.

43. A lithographic apparatus comprising:

a beam receptor constructed and arranged for receiving a beam of radiation;

an optical attenuator device for improving a homogeneity of the beam of radiation which is located in the beam of radiation, said optical attenuator device comprising at least one optical attenuator element which removes at least a part of said radiation from said beam of radiation, which is located in the beam of radiation;

a support structure for supporting a patterning device, the patterning device serving to impart the homogeneous projection beam with a pattern in its cross-section, thus providing a patterned beam;

a substrate table for holding a substrate; and

a projection system to project the patterned beam onto a target portion of the substrate.

44. A lithographic apparatus comprising:

a radiation system according to claim 36, to provide a projection beam of radiation;

a support structure to support a patterning device, the patterning device serving to impart the projection beam with a pattern in its cross-section;

a substrate table to hold a substrate; and

a projection system to project the patterned beam onto a target portion of the substrate.

45. The lithographic apparatus according to claim 43, wherein said patterning device and substrate table are movable with respect to the beam of radiation in a scanning direction, said beam of radiation being incident on the patterning device on an incidence area, wherein the at least one optical attenuator element is present in a part of the beam corresponding to said incidence area.

46. The lithographic apparatus according to claim 44, wherein said patterning device and substrate table are movable with respect to the beam of radiation in a scanning direction, said beam of radiation being incident on the patterning device on an incidence area, wherein the at least one optical attenuator element is present in a part of the beam corresponding to a central part of said incidence area.

47. A device manufacturing method comprising:

producing a projection beam of radiation using a radiation system constructed and arranged to provide a beam of radiation with a homogeneous intensity distribution, comprising a source of radiation, a collector constructed and arranged to collect said radiation into the beam of radiation, and an optical attenuator device comprising at least one optical attenuator element which removes at least a part of said radiation from said beam of radiation;

patterning the projection beam with a pattern in its cross-section; and

projecting the patterned beam of radiation onto a target portion of a substrate.

48. An optical attenuator for use in a lithographic apparatus comprising:

an attenuator element disposable in a radiation beam path of the lithographic apparatus, such that the attenuator element extends along a narrow, central region of the beam path, the attenuator element comprising a material having a transmissivity of less than 100% at a wavelength of radiation of the lithographic apparatus.